

Measurement of the Parity-Violating Gamma Asymmetry A_γ in the Capture of Polarized Cold Neutrons by Para-Hydrogen, $\vec{n} + p \rightarrow d + \gamma$

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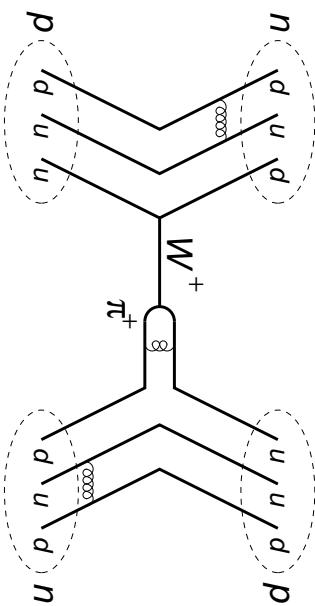
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Hadronic Weak Interaction

- Weak couplings (H_π^1 , $H_\rho^{0,1,1',2}$, $H_\omega^{0,1}$) modified by strong interaction

example: $n + p \rightarrow n + p$



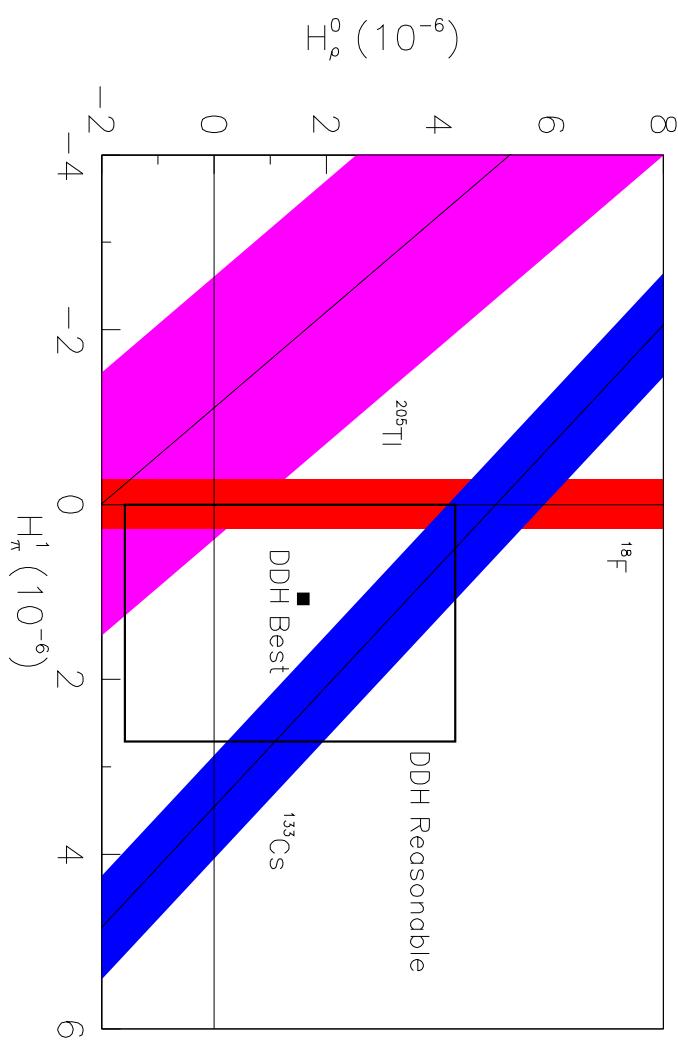
- Can calculate approx. from QCD

- Need weak couplings from experiment
- Weak interaction in nuclei:

$$V = \sum_{m,\Delta I} H_m^{\Delta I} V_m^{\Delta I}$$

$$\langle Q_{pv} \rangle = 2 \sum_{m,\Delta I} \langle \psi | Q_{pv} | \phi \rangle \frac{H_m^{\Delta I} \langle \psi | V_m^{\Delta I} | \phi \rangle}{\Delta E}$$

Weak Couplings from ^{18}F , ^{133}Cs , and ^{205}Tl

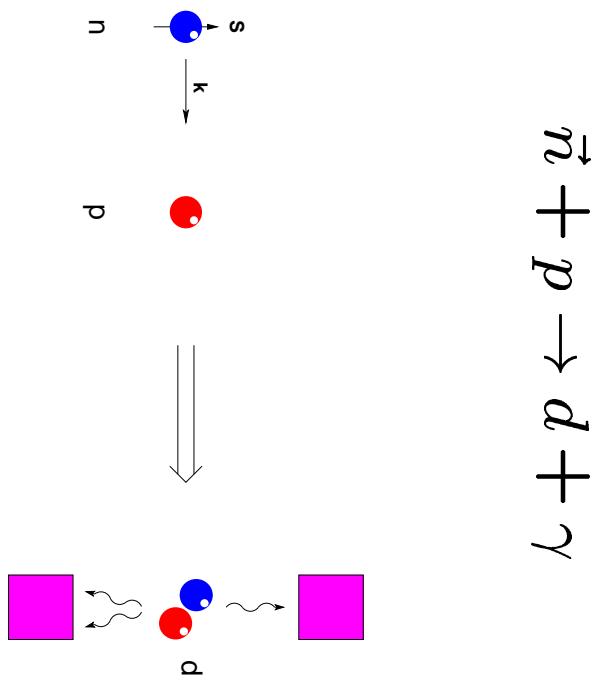


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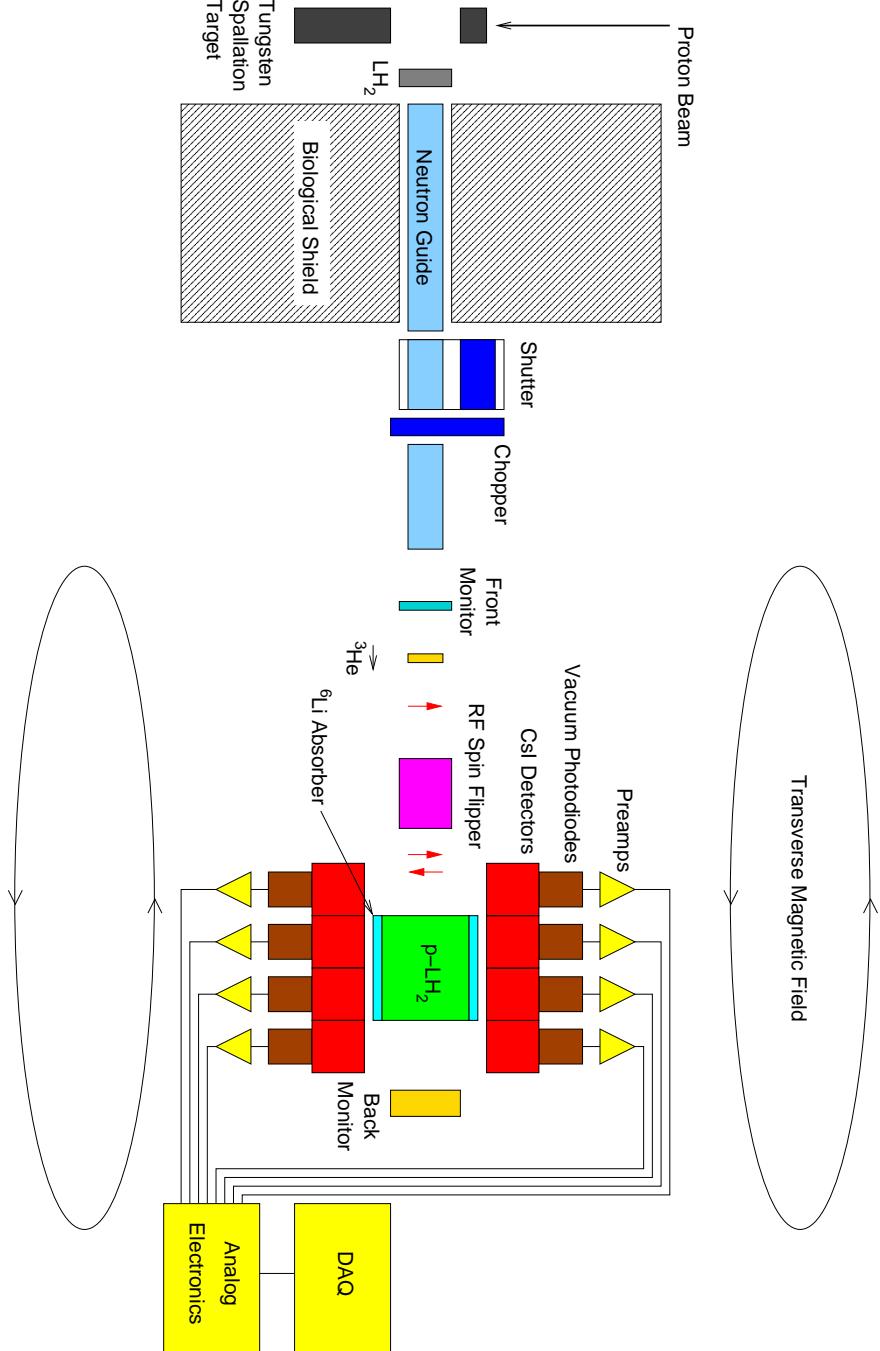
H_π^1 in the Hadronic Weak Interaction

- **QCD sum rules**
 - Henley, Hwang, and Kisslinger (1996 and 1998)
$$H_\pi^1 \sim 6 \times 10^{-7}$$
- **$SU(3) \chi\text{PT}$**
 - Kaplan and Savage (1993)
$$H_\pi^1 \sim 12 \times 10^{-7}$$
 - Meißner and Weigel (1998)
$$H_\pi^1 \sim 4 \times 10^{-7}$$
- **Observables**
 - Kaplan, Savage, Springer, and Wise (1999)
$$A_\gamma \text{ in } \vec{n} + p \rightarrow d + \gamma$$
 - V.R. Brown (1999)
Comprehensive study of NN observables

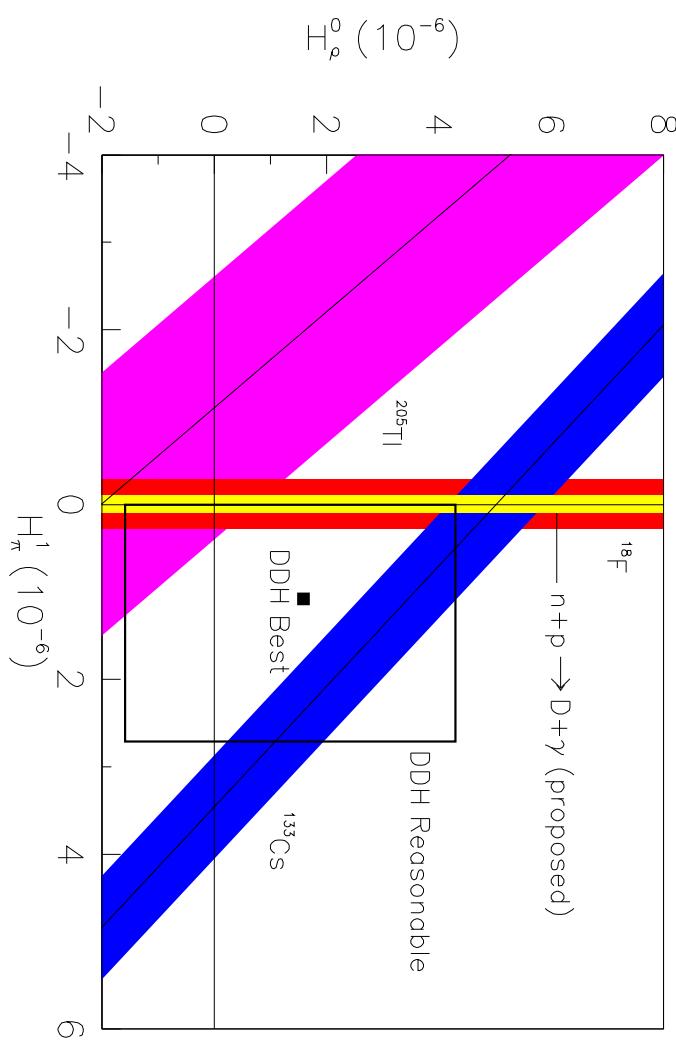
$$A_\gamma = \frac{1}{P_n} \frac{N_u - N_d}{N_u + N_d} \approx -0.045 H_\pi^1 \sim -5 \times 10^{-8}$$



$\bar{n} + p \rightarrow d + \gamma$ Experiment



Expected Uncertainty from A_γ in $\vec{n} + p \rightarrow d + \gamma$

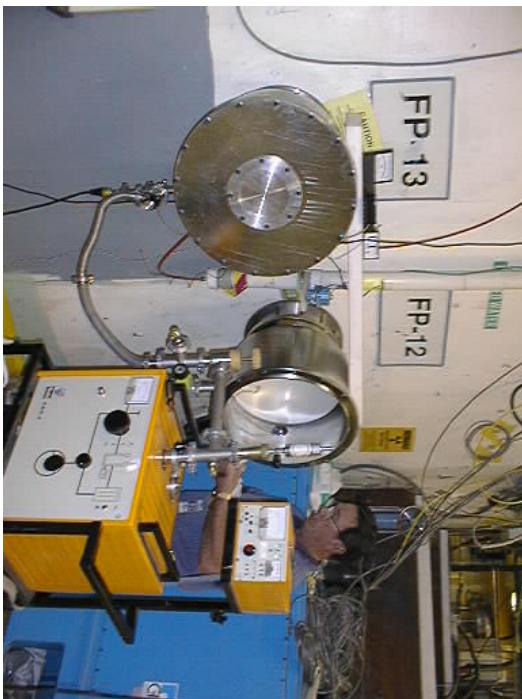


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Status of the $\vec{n} + p \rightarrow d + \gamma$ Experiment

- Prototypes of all major components tested with beam
Achieved $\sim 10^{-6}$ statistics $\sim 10^{-7}$ systematics
- Construction of beam line in progress
World's most intense pulsed cold beam
- Commissioning expected in 2002

Beam Line Construction



Summary

- H_π^1 is the most import weak nucleon-nucleon coupling
- $\vec{n} + p \rightarrow d + \gamma$ will measure H_π^1 with no nuclear structure uncertainties
- Successful test complete
- Beam line under construction